

Verification and Validation of Neuro-Adaptive Controllers in the Power Industry

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Abstract: Over the past ten years, Pegasus Technologies has commissioned over 100 neural network based adaptive controllers in the Power Industry. These controllers have been used to substantially reduce air pollution emissions such as nitrogen oxides (NOx) from large coal fired, power plants. In addition, these controllers have been used to improve overall efficiency of power plants. In order to reduce emissions and improve efficiency, the controllers directly manipulate the air to fuel distribution in the furnace. Control of the furnace is made challenging by the following: 1) the air and fuel enter the furnace in many different locations, 2) the combustion reactions are inherently nonlinear and difficult to model and 3) the furnace is constantly changing due to soot build-up and slagging on the heat transfer surfaces. To properly control such a process, an adaptive, nonlinear (neural network), multivariable controller is needed. Verification and validation of these controllers is required because of the significant safety and maintenance issues associated with directly manipulating the air and fuel distribution in the furnace. This presentation will focus on how the technology used for neuro-adaptive control of furnaces has evolved over the past 10 year to allow verification and validation of these controllers. Specifically, the presentation will outline how a model predictive control system that uses an adaptive neural network in a unique two point gain scheduling formulation has evolved to overcome common concerns associated with verification and validation of neuro-adaptive controllers in the power industry.